Fire Island Transmission Line and Wind Power Preliminary Engineering Report

by Chugach Electric Association
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Abstract

Chugach Electric undertook wind generation studies in 1998. Seven years of resource studies have indicated Fire Island as an economic wind energy resource and identified it as the best South Central Alaska wind energy site. Preliminary engineering studies covering siting, environmental, civil, electrical issues and wind turbine technology have confirmed the technically viability of the project, but a permitting related issue of the FAA's determination of presumed hazard remains unresolved.

The potential projected capacity is 36 to 72 MW and the estimated cost for a 72 MW project in 2005$ is $212.6M, which is relatively costly. Government funding is required to move forward with the project. After notice to proceed it will take approximately 3 years to complete the project.

CHUGACH
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Project Analysis Report
Plant Technical Services

Title: Fire Island Transmission Line and Wind Power
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Purpose
This report is a summary of studies and developments in part funded by the Denali Commission to provide interested parties with a basis for moving forward with the project should FAA withdraw its objection and impetus occur due to increased government funding.

1. Relevant Parties to the Analysis

1.1. Tryck Nyman Hayes, Inc.

1.2. Dryden& LaRue, Inc.

1.3. Electric Power Systems, Inc.

1.4. Shannon & Wilson, Inc.

1.5. Trawver Land Services

1.6. URS, Inc

1.7. Charles M. Mobley & Associates

1.8. ABR, Inc. – Environmental Research & Services

1.9. Terranova Power

1.10. Harding ESE

1.11. GE Wind Turbines

1.12. Vestas Wind Turbines

1.13. Chugach Electric Association

1.14. Basin Electric Cooperative

1.15. enXco

2. Chronology

The chronology captures the dates of events and findings relevant to the report subject.

Date	Event
1998	Kick off of wind resource studies
2000	Begin meteorological measurements on Fire Island
2001	Potential sites narrowed to Arctic Valley, Bird Point, Portage, Fire Island
2001	CIRI and Chugach enter MOU to study Fire Island wind power
2001	Wind project construction engineering studies begin
2002	Line extension studies reveal feasibility of the four short list sites
2002	Arctic Valley and Portage eliminated from short list of sites
2003	Bird Point eliminated from short list of sites
2004	Denali Commission awards funds to Chugach for Fire Island infrastructure study
2004	Fire Island resource and siting studies complete
2004	Chugach submits Notice of Proposed Construction Form 7460-1 to FAA
2005	Preliminary engineering study identifies feasibility of Fire Island site
2005	FAA issues Determination of Presumed Hazard on proposed wind project
2006/7	Aeronautical studies by FAA, Chugach and others to resolve potential hazards
Current	Waiting for FAA to make a determination based on new studies and data

3. Discussion & Analysis

3.1. Wind Resource and Siting Studies

3.1.1. Meteorological studies were done to quantify the wind speed and other wind characteristics used to screen potential sites. Siting studies on over twenty windy sites on the southern end of the Railbelt were considered and eliminated after consultation with technical and environmental experts, regulatory and conservation groups, and landowners. Data collection on Fire Island began in 2000 and has continued to date with all funding for wind data collection provided by the utilities and CIRI. CIRI has continued wind resource studies. The wind resource meets industry standards (wind speed, turbulence, etc.) for a project. Fire Island has the largest wind generation potential of the evaluated sites and exceeds wind resource standards for a project site.

3.1.2. Typical wind project development guidelines recommend data collection for two years to provide project developers with sufficient data for making the investment decision. Chugach has five years of data and meteorological studies on Fire Island. The average wind speed exceeds the industry's 30% Capacity Factor (C.F.) minimum resource requirements. The studies quantify the amount of wind generation Chugach would generate using wind turbines in the 1.5 to 3 megawatt size range. The studies also evaluated several rural scale wind turbines due to the potential of including a statewide training component adjacent to the power generation facilities.

3.1.3. Using the wind data, a preliminary siting study in 2005 was done to determine a location for 33 turbine sites on Fire Island. Subsequent discussion and studies in collaboration with FAA have resulted in locations for 24 turbine sites on Fire Island. See Figure 1. This information has been used as the basis for subsequent studies of power line, road, substation, civil infrastructure and the barge landing.

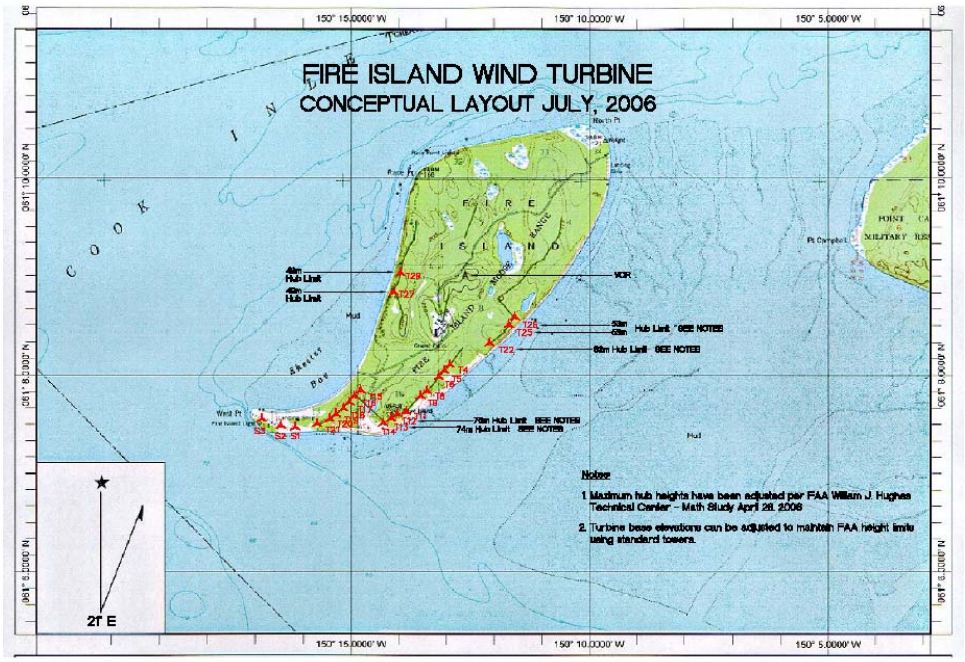

Figure 1

3.1.4. The proposed wind turbines sites are all on Cook Inlet Regional Inc, (CIRI) land. CIRI indicated in writing its intent to provide right-of-way without charge and to phase in turbine site lease rates over five years. Fire Island consists of approximately 4000 acres of land of which 1000 is owned by the United States Federal Aviation Administration and Coast Guard, and 3000 by CIRI. Power lines will cross FAA and Coast Guard lands. These agencies expressed interest in purchasing power from the grid when it becomes available.

3.1.5. Chugach has been working with the FAA since 1998 on wind studies and met with agency representatives numerous times in general discussion about prospective sites and more specifically Fire Island. In early 2004, Chugach submitted to FAA Form 7460-1 Notice of Proposed Construction for a transmission line and wind project. The FAA assigned personnel to model a wind project on the island and the agency issued a Determination of Presumed Hazard to Chugach on September 2, 2005. Subsequent collaboration between Chugach and FAA includes identifying turbine locations of concern, requiring shorter turbine towers and moving or deleting some proposed turbine locations. Joint collaboration also included a series of studies to investigate and recommend hazard mitigation measures. The FAA ASR-11 radar original equipment manufacturer, Raytheon, and FAA's radar consultant Regulus participated in these studies. In Fall 2007, FAA's representative said FAA is expected to issue its finding in November 2007. To date, FAA has not issued a finding based on the current studies.

3.2. Environmental Studies

3.2.1. Environmental studies on Fire Island revealed no significant environmental impediments to development of the site. With respect to the environmental issues studied, the public concerns typically focus on avian conflicts, view-shed and noise. Avian studies during spring and fall in peak bird migration seasons were done to address fish and wildlife regulatory concerns. View-shed and noise are not issues due to the site location.

3.2.2. Consultations with the US Fish and Wildlife Service have been on going since 2000. As a result of US F&WS input, Chugach studied the spring and fall avian migration in the Fire Island area during 2004. Two biologists were stationed on the island and one in Anchorage at an FAA radar facility observing birds passing over the island at night. This study found that spring bird migration over the island was more than expected and fall migration was less than expected. Raptor surveys done in May 2005 and Jan./Feb 2006 found little use of the island by Bald Eagles. Consequently the consultant concluded avian issues would not significantly impact the project.

3.2.3. The 2004/5-infrastructure study included scoping level environmental and archeological reviews, historical uses of the land, proposed location of roads, power lines and turbines and possible permit requirements.

The infrastructure study also included a lands boundary and ownership analysis of infrastructure routes on both the island and mainland sides of the water. The island side lands are primarily CIRI owned. Chugach has a letter of agreement with CIRI. Ownership and perspective routing was investigated for the mainland side to make recommendations for power line alignments. The Woronzof to Fire Island route has few right-of-way issues. The Raspberry to the Fire Island route is more complex. However, Chugach currently has right-of-way along a route that runs along the boundary of Kincaid Park and the airport. This route makes up a large part of the route from the substation to the water.

The environmental study included a meeting, held in October of 2004, with approximately 30 state and federal representatives. A project overview was provided for the attendees with time allowed for questions. FAA expressed possible concerns related to navigational aids and was conducting a study. The DOT expressed concern about overhead power lines near the airport. No other concerns were expressed.

3.3. Electrical Interconnection Studies

3.3.1. Two electrical interconnection studies were conducted in late 2001 and early 2002. A more detailed study completed in 1stQ 2005 developed preliminary cost estimates and identified optional transmission line routes from the Chugach grid to Fire Island.

3.3.2. The proposed transmission line routes are from Fire Island to either of Chugach's Raspberry or Point Woronzof substations. The interconnection also includes line extensions to FAA, Coast Guard and FBI facilities on Fire Island. All options include a submarine cable trenched into the tidal flats between the Island and Anchorage.

3.3.3. The 2004/5 Study defined interconnection options A, B and C. A is a fully redundant 138-kV interconnection and highest cost. Option B doesn't include redundancy, is a 138-kV interconnection and allows for all power produced on the island to flow to the grid yet still maintains acceptable reliability. Option C would support a smaller wind project, not require a new substation, connects at 35-kV, and includes a redundant submarine cable.

Features of option A are not considered necessary until significant economic development occurs on Fire Island. Estimates for electric infrastructure are shown in the following table.

Transmission Line Options

A	B	C
138 kV	138 kV	35 kV
Redundant	Single Circuit	Redundant
$46,033,000	$30,640,000	$15,379,000

3.4. Civil Infrastructure Studies

3.4.1. Chugach's on-site geological investigations began in 2001 as a component of developing cost estimates of turbine foundations. Fire Island has been the proposed site for several economic development proposals. Significant civil engineering information from these studies is available and was used in the 2004/5-infrastructure study.

3.4.2. A civil infrastructure study performed in 1stQ 2005 identifies road alignments, a barge landing and conceptual footing designs for the wind turbines. This body of work includes geotechnical studies used in the analysis. Gravel pits on the Island were identified. The gravel will be needed for construction of roads, a barge landing, turbine foundations and electric infrastructure. The geotechnical study included eleven, 100-foot borings, to verify the suitability of the soils for wind turbine foundations.

The study concluded the existing road, originally installed by the military, will need widening, and determined new roads are feasible with material available on the island.

A barge landing will be required for project construction. The civil infrastructure study analyzed 5 alternative barge landing planning concepts. A site on the Northeast end of Fire Island is the preferred landing site. Permit requirements and potential other long-term uses of the landing may influence which design concept is selected for construction.

3.5. Wind Turbine Construction and O&M Studies

3.5.1. Wind turbine construction cost estimates were developed from turbine equipment bids and on-site consultation with wind project construction engineers. Validation of these estimates included comparisons with actual wind project development costs from published sources, and consultation with equipment manufacturers, developers, utilities, and wind project owners. O&M cost estimates were developed in a similar manner.

3.5.2. The wind turbine construction cost study was initiated in 2001 during the project siting evaluations. At the time, four sites were on the short list for consideration. The wind turbine project construction engineer visited sites with a geotechnical engineer. The work included site evaluation and consultation with local construction and transportation companies. The study provided a detailed spreadsheet of construction activities and cost estimates. This construction cost estimate was updated in 2005 with information from the detailed infrastructure studies.

3.5.3. Approximately 60% of the wind turbine project cost (including electrical and civil infrastructure) is the cost of wind turbines. In 2002, Chugach issued a request for information to wind turbine manufacturers capable of providing turbines in the 1 to 3 megawatt size. The proposal process allowed manufacturers to provide confidential non-binding quotes and supporting information.

Prices submitted to Chugach in 2005 were comparable, although higher, than turbine prices obtained by large project developers in the lower 48. This information is used in Chugach's construction cost estimates and has been updated to reflect 2007 cost estimates for turbine prices.

The following illustration shows the scale of a 1.8-megawatt wind turbine on the right, and a 60-kilowatt wind turbine on the left.

3.5.4. Wind turbine project O&M cost estimating was initiated in 2001. Few large wind project developers disclose O&M costs for competitive reasons. However, several large public wind power developments such as Energy Northwest near Richland, Washington share data. Chugach O&M estimates are based on industry data escalated for Alaska wage and transportation adjustments.

3.6. Cost Analysis

3.6.1. Electrical infrastructure alternatives and cost estimates were developed in 2004 and 2005 for three scenarios as noted in 3.3 Electrical Interconnection Studies.

- Interconnection to the Anchorage power grid by redundant 35-kV submarine cables capable of transmitting 25 MW over a single cable, and up to 45 MW if both cables were used.
- Interconnection to the Anchorage power grid by a single 138-kV submarine cable capable of transmitting 100 MW.
- Interconnection to the Anchorage power grid by a single 138-kV submarine cable capable of transmitting 100 MW, with a second 138-kV submarine cable installed for contingencies.

3.6.2. The infrastructure costs plus a 25% contingency, with the single 138-kV submarine cable option, were updated in October 2006 and are as follows:

Electrical with 138-kV single circuit	$37,300000
Civil	$11,600,000
Barge Landing	$5,300,000
Total - Infrastructure	$54,200,000

3.6.3. Fifty MW and above are considered large projects. Some economy of scale will occur with a 100 MW project, however economies of scale are not included in this level of analysis for the “Wind turbines and facilities”. A 100 MW project will be more economically viable than a 50 MW project. Fire Island could support 120 MW of wind developments. The project size has been reduced to 36 to 72 MW to address FAA concerns over interference with aviation systems. As these systems are updated, a larger project can be considered.

3.6.4. Chugach’s cost estimate for wind turbines is documented in Chugach’s 2005 IRP Studies and is $1,350 per kW. Both a 50 MW and a 100 MW project were being considered. Estimates in October 2006 were updated to $1,750. Project costs of wind turbines for 2007 are $2,100 to $2,200. The most recent 2006 infrastructure cost estimates are shown in the following table.

	72 MW
Total - Infrastructure	$ 54,200,000
Wind turbines and facilities	$ 158,400,000
Total	$212,600,000

3.6.5. Chugach's 2005 cost estimates for O&M is approximately $660,000 annually for a 50 MW project and twice as much for a 100 MW project, and includes a re-powering cost after 20 years. Chugach Corporate Analysis and Planning's model uses data from Chugach's IRP and the economic results are similar.

3.6.6. Several funding and financial projections have been performed during the study period showing the project to be viable. This data has not been updated. The wind resource data indicates a project capacity factor of 39% (gross) and Chugach is using 33% (net) in its economic evaluation to conservatively account for variations in year to year wind conditions. The business model typically considered is for a developer with access to Federal Tax Credits builds the wind project, a utility builds the electrical interconnection, and the utility buys wind power from the developer.

3.7. Utility Coordination

3.7.1. In mid 2004 Chugach, AML&P and GVEA signed an MOU agreeing to work together to fully explore and if possible install a wind project on Fire Island. The companies have met several times and Chugach has shared all pertinent data with the other two utilities. In February of 2005 HEA signed on as a participant bringing the total to 4 Railbelt utilities wishing to bring power into the grid from Fire Island.

The MOU Partners periodically meet to discuss developments and have included CIRI in some of its meetings. CIRI has outlined its interest in developing the wind project on Fire Island and selling power to the utilities. CIRI has formed an LLC with enXco to investigate and develop the Fire Island wind project and investigate other wind resource sites. No further discussions have occurred since early 2007.

4. Conclusions & Recommendations

4.1. The studies have shown the project can be permitted and is technically viable.

4.2. As with all renewable projects, such as hydro for instance, the upfront cost of installation is steep. However the ratepayers' benefit because the power becomes cheaper over time relative to fossil fueled generation. To bring wind power at Fire Island on-line within the next few years grant funding will be needed to address the high capital infrastructure costs for the power line, roads and barge landing.

4.3. The next item to address before the project can proceed is the FAA Determination of Presumed Hazard issued prior to additional navigational studies and modifications to turbine site plans. The FAA may issue a finding in mid-2008.

4.4. Recommendations

- Seek funding for the infrastructure; power lines, roads and barge landing.
- With funding in place, begin permitting and development of construction ready design.
- Establish operating agreements between utility partners.
- Build power line, roads, barge landing and wind project.

4.5. Recommended schedule

Date	Event
2003	Resource assessment complete
2004	Avian studies complete
1st Q 2005	Infrastructure and siting studies complete
2nd Q 08	Obtain FAA Notice of No Presumed Hazard
2nd Q 08 – 1st Q 09	Develop construction ready design
2nd Q 08 – 1st Q 09	Secure permitting
1st Q 09 – 2nd Q 09	Issue RFP for construction, award contract
3rd Q 09 – 2nd Q 10	Project construction
3rd Q 10	Project commissioning
4th Q 10	Project dedication
3rd Q 10 – 3rd Q 11	Warranty period

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